

# **Integrative Model of Temperature and Early Life History of Chinook Salmon**

**Ronald M. Coleman**

## **Public Comments**

No public comments were received for this proposal.

# Technical Synthesis Panel Review

## Proposal Title

#0129: Integrative Model of Temperature and Early Life History of Chinook Salmon

Final Panel Rating
<b>inadequate</b>

## Technical Synthesis Panel (Primary) Review

### TSP Primary Reviewer's Evaluation Summary And Rating:

RATINGS: Reviewers, fair, good, very good. ME: Inadequate. The goals of this project is to (1) conduct laboratory experiments and field measurements to obtain relationships between temperature, and egg development and survival, and (2) build and individual based model to predict effects of temperature on egg development and mortality in chinook salmon. The justification for this project was good. The authors cites old studies that did not carefully measure temperature effects on egg development. However, it is my experience that these old studies still are very useful in predicting egg development time and hatch. Another justification provided was that temperature drops will affect survival. This is certainly true. Also, temperature may greatly affect fungal infections and mortality in salmon eggs. however the author did not provide sufficient data to suggest that this actually causes year class failures for salmon populations in the American River or other areas. NO Hypotheses were presented. Details of methodology were incomplete. The author proposes to conduct lab experiments looking at survival and development of eggs at different temperatures. The choice of temperature drops is not explained. Is this an realistic temperature drop? Then he will accurately measure water temperature and egg development in hatcheries, measure temperatures in redds in American River. Finally, he will use data to construct an IBM of egg

#0129: Integrative Model of Temperature and Early Life History of Chinook Salmon

## Technical Synthesis Panel Review

mortality. Details of model structure or possible simulations are not presented. It is not clear what will be done with the results. No statistics were presented for lab analysis. No information was provided on size or source of eggs. The proposal could have been improved by using the IBM to predict mortality for salmon eggs in river, then compare with real data? I felt the PI overstated costs and need for an expensive computer. He can get one at 25% of the cost that will do the job. Also, he is covering much of his salary on this grant. He could just as well pay a technician to do lab experiments.

### Additional Comments:

Outreach component of this proposal was lacking. The author intends to publish his results, but does not mention the distribution of the model to hatchery managers who may benefit from it. The author has no experience in working with salmon eggs, although substantial experience working with cichlids.

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## Technical Synthesis Panel Review

accurately measure water temperature and egg development in hatcheries, measure temperatures in redds in American River. Finally, he will use data to construct an IBM of egg mortality. Details of model structure or possible simulations are not presented. It is not clear what will be done with the results. No statistics were presented for lab analysis. No information was provided on size or source of eggs. The proposal could have been improved by using the IBM to predict mortality for salmon eggs in river, then compare with real data? I felt the PI overstated costs and need for an expensive computer. He can get one at 25% of the cost that will do the job. Also, he is covering much of his salary on this grant. He could just as well pay a technician to do lab experiments.

## Technical Synthesis Panel (Discussion) Review

### TSP Observations, Findings And Recommendations:

The goal of this project is to create an integrative, individual-based model to understand and predict the effects of changes in water temperature on survival and growth of early life history stages of Chinook salmon in the Lower American River.

The study has merit, but suffers from several factors, including a clear methodological and hypothesis driven approach. Several details in methodology were lacking such as sample size, handling procedures, origin and size of eggs for the temperature egg experiments, and structure of the IBM. There was inadequate justification for considering abrupt temperature drops based on past river temperature data.

The author did not discuss where to put data loggers in the river, or in the redd. Based on author's past work, and the details of the proposal as written, the panel did not feel he had enough understanding either of the chinook salmon life history, or individual-based modeling, to carry out this project.

The need for the study was not well justified. Temperature certainly affects development rates and survival of eggs, but

## Technical Synthesis Panel Review

no information was presented to suggest this really was a problem in the American River or elsewhere. Although studies looking at temperature effects on salmon egg development were conducted many years ago, these relationships do provide a good estimate for hatchery managers to predict development and hatch of salmon eggs. The budget was considered excessive especially in regards to technology.

Rating: INADEQUATE

# Technical Review #1

proposal title: Integrative Model of Temperature and Early Life History of Chinook Salmon

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	One of the primary goals of the CALFED Science initiative is to provide quantitative measures of known biological stressors influencing salmonid demography and life history. As stated, this proposal seeks to clearly quantify effects of temperature on egg hatching success in Chinook salmon. The goals of the study are to understand effects of temperature on egg hatching success in a laboratory setting. This allows for the construction of a predictive model. This model will then be tested in hatchery settings, providing valuable information on the time to hatching for hatchery managers. The objectives are clearly stated and timely because few (relatively old) studies have summarized the effects of temperature on egg hatch success rates. This study also addresses a critical stage in the life history of Chinook salmon that has been, for the most part, overlooked. Thus this proposal seeks to address the association between temperature and differential egg mortality rates in Chinook salmon. This study could have large demographic implications for Chinook salmon if minor fluctuations in temperature profoundly influence mortality rates.
Rating	very good

## Technical Review #1

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	<p>This study is justified given that there are only a few such studies that have addressed water temperature vs. egg hatching success. No study has tried to model this effect for Chinook salmon in a known system. The model is clearly stated and explains the underlying basis for the work. My only comment is that although temperature appears to affect hatching success in eggs (which is a large part of the study), delayed hatching will not adversely affect the demography of the population. What may have a large influence on the demography of Chinook salmon is mortality rate. This proposal seeks to explain both of these phenomena in the laboratory, and this is clearly stated and attainable. Yet, like any model, it is based on laboratory findings, and may not be suitable for predicting mortality in the Lower American River. Along with monitoring temperature profiles in this river system, why not design a study to see how well the model predicts mortality rates in the Lower American River. Furthermore the model suggested by the author indicates the developmental rate is linked solely with the environment and as such is only documenting changes that happened with respect to temperature. If there are any genetic or genetic x environment effects (which literature suggests) then the model may not be accurately predicting any decline in demography. This should be further addressed in the laboratory phase of the project by insuring that eggs used for this experiment are a random subset of what is found in the wild (for each replicate) so that the genotypes are randomly dispersed among replicates. Also, the author is unclear about the hydrology flow regime currently impacting the Lower American River. Are there numerous releases taking place during this critical life history stage or are water releases more</p>
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## Technical Review #1

	prevalent during May-August and thus not affecting egg hatching success. Unless the former is true, then this study is not of high priority.
Rating	very good

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	This is a well designed approach to addressing areas of uncertainty in egg hatching success vs. temperature. They combine laboratory experiments to generate a model predicting hatch time for eggs at various temperatures, and test this model in various hatchery settings. This is a very feasible study and will add significantly to the base of knowledge concerning the early life history of Chinook salmon. The model generated from these experiments will ultimately allow managers to make more decisive decision regarding timely water releases.
Rating	very good

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	The design is fully documented, technically feasible and within the grasp of the author. Again my main concern is how well will the model depict mortality rates in natural settings
Rating	very good

## Technical Review #1

### Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

<b>Comments</b>	N/A
<b>Rating</b>	not applicable

### Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	This proposal will make timely and valuable contributions to larger data management systems by i) describing a poorly known early life history stage in Chinook salmon, and ii) creating a predictive model that allows managers to more accurately calculate the results of timed water releases from impoundments
<b>Rating</b>	very good

### Additional Comments

<b>Comments</b>	N/A
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### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

<b>Comments</b>	Although the author has limited experience working with Chinook salmon, he has performed the outlined experiments using cichlid species; thus his understanding of the methodology allows for efficient implementation of the project. Addressing his CV, he
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### Technical Review #1

	has not been leading author on any publication dealing with model-based simulations, which leaves some doubt about the author's effectiveness to complete the modeling portion of this study. Having said this, the model outlined in the proposal appears feasible.
<b>Rating</b>	very good

### Budget

Is the budget reasonable and adequate for the work proposed?

<b>Comments</b>	Budget appears to be adequate
<b>Rating</b>	very good

### Overall

Provide a brief explanation of your summary rating.

<b>Comments</b>	The proposal is a very timely and needed study to understand the early life history of Chinook salmon. I have some reserves about the predictive model (addressed above), and about the authors background in computer modelling. Still these data will make valuable contributions to management decisions and understanding how temperature influences early life history development in Chinook Salmon.
<b>Rating</b>	very good

# Technical Review #2

proposal title: Integrative Model of Temperature and Early Life History of Chinook Salmon

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	The goal of this study is to develop an individual-based model of the effects of temperature on the early life history stages of Chinook salmon in the American R., using existing bodies of data and new data collected from laboratory and field studies. No hypotheses are presented, nor is a conceptual model of the ways in which water temperature can directly or indirectly affect eggs provided.
Rating	fair

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The author is correct in pointing out that water temperature is a major issue on the lower American River and that despite all of the studies completed to date there exist no single model or predictive tool that can answer the question of what happens to eggs if they are exposed to temperatures of X or Y for Z days.
Rating	good

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	<p>The approach for the laboratory portion of the study is overly simplified and lacking in important details, such as the source for the eggs (Nimbus? Coleman? Feather R.?) or the nature of the recirculating system. If the investigator truly wishes to include the effects of temperature-related factors such as disease, then careful thought needs to be put into the water treatment system, or lack thereof. Chinook salmon eggs are not cichlid eggs, and their care is significantly different. What are the different egg sizes that will be used? There is no justification of sample sizes, no description of the water supply (which could definitely influence the prevalence of Saprolegnia), or even mention of egg treatment before and during the incubation period. The author makes no mention of how they would deal with the known maternal effects on egg development and survival. I would recommend that the investigator consult with hatchery personnel to learn more about Chinook salmon egg and larval care and amend the proposal accordingly. The details on Subtask 2 are also lacking. Where will the temperature data loggers be placed? At the surface of the redds, 10 cm down, below the redds? There are likely important temperature differences found in relatively small vertical distances in the redds, yet this is ignored. Again, the investigator appears not to have a strong knowledge of salmonid spawning biology. There is also no mention of sample size, logger locations, or any of the other details that would be pertinent to a study of this nature. Subtask 3 is equally vague...which hatcheries? Have they already agreed to the use of their facilities for the monitoring of temperatures and egg development times? Task 2 is described in somewhat more detail than Task</p>
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## Technical Review #2

	1, but is still lacking key information. The author alludes to the use of data from the proposed studies, past studies, and possibly spatial structure, temporal variation in spawning, etc., but disappointingly does not list all the parameters that will be initially entered into the model. I feel that this again demonstrates the investigators unfamiliarity with Chinook salmon, despite their record working with tropical fishes.
Rating	fair

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?  
Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	As currently described the project is not feasible, not because it requires specialized techniques or has a high risk of failure, but because the proposal does not demonstrate the investigator is familiar with the subject matter (Chinook salmon eggs) or the requirements for conducting laboratory and field studies on the same. The investigator definitely has the background required to do such work but until a greater understanding of the techniques and equipment needed is demonstrated, it is not possible to say the project, as proposed in the document, is feasible.
Rating	fair

## Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	N/A
Rating	not applicable

## Technical Review #2

### Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	While the investigator should be commended for planning to publish the results in peer-reviewed journals, I was surprised that there were no plans to distribute the information to resource managers on the American River, or even to the hatchery managers who are, for the lack of better information, using an admittedly imprecise method of estimating hatching time. A future version of this proposal should include a more detailed data dissemination plan, and might benefit from the inclusion of an extension agent to ensure that key stakeholders receive, and use the developed information.
Rating	fair

### Additional Comments

Comments
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### Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	Though the investigator has significant familiarity with fish egg and development studies, there is clearly a lack of understanding about some of the issues particular to salmonid eggs, or even a strong familiarity with the literature on the effects of temperature and egg size on salmonid egg biology. I have strong reservations about their ability to complete this project in a timely manner.
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## Technical Review #2

<b>Rating</b>	good
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### Budget

Is the budget reasonable and adequate for the work proposed?

<b>Comments</b>	The budget is not unreasonable for a project of this scope.
<b>Rating</b>	very good

### Overall

Provide a brief explanation of your summary rating.

<b>Comments</b>	This proposal has the appearance of something that was hastily prepared by someone who is not very familiar with the techniques needed to conduct laboratory studies of salmonid egg biology. The overall lack of crucial details, of a clear experimental objective, and of deliverables that would be useful to the resource management community in a timely manner (as opposed to the delay imposed by publication in peer-reviewed journals) make this a poor choice for funding. However, the idea is a good one and should be pursued in a subsequent submission, if this remains an area of interest for CalFed. I recommend that the investigator speak at length with hatchery managers, fish physiologists, etc., to gain a better understanding of the requirements of such a study and also put more time, and detail into any future submissions.
<b>Rating</b>	fair

# Technical Review #3

proposal title: Integrative Model of Temperature and Early Life History of Chinook Salmon

## Review Form

### Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	The goals, objectives, and hypotheses are clearly stated. The idea is timely, but it is hard to determine if it is as important as the author claims. For example, no analysis of the variability in peak smolt out migration is mentioned to determine if there is any evidence that temperature related shifts in egg development, induced by operational changes, has resulted in significant delays of development/emergence. The strong relationship between temperature and development suggest that important shifts can occur, but no data were presented to indicate that operational changes may have caused or can cause significant delays.
Rating	good

### Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full-scale implementation project justified?

Comments	The study is justified based on understood relationships between egg development and temperature. However, it is not well justified based on existing
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### Technical Review #3

	<p>data from the river indicating that operationally related shifts in water temperature has occurred. The author claims that a two-degrree drop in temperature may occur in the Lower American River, but presents no data or analysis to substantiate that claim. A conceptual model is not explicitly stated, although one is used as the author describes how temperature affects development of eggs. The research design is well thought out, but requires multiple, related task to be staged at the same time without the benefit of field (or analysis of existing data) that may allow a more focused experimental design. For example, the laboratory experiments go in 2 degree intervals across and undefined range; if the range of temperature change in the actual system were better understood this experimental design could be focused on that range (assuming scope equals effort and cost). Consequently, I feel that substantial gains could be made if this work were phased in...with field work preceding the lab work and model development.</p>
<b>Rating</b>	good

## Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

<b>Comments</b>	<p>The approach is well designed and appropriate, with the condition that phased in studies might prove more effective. The experimental and field approach presented is very feasible. The field monitoring of egg development is vitally important since the water temperature in the redds may not be the same (or temperature changes could be of different magnitude and duration)as observed in the water column. Phasing this reasearch to collect the field data first might create important efficiencies</p>
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### Technical Review #3

	<p>in the laboratory and modeling tasks. The individual based modeling is also feasible, but the author is pushing the capacity of this modeling approach by trying to model the egg population. He does not offer any analysis of how many eggs the model can realistically be expected to follow. Yet with salmon females capable of laying 3000-8000 eggs each (depending upon age, etc.), an individually based model may soon become overwhelmed by the shear numbers of "units" it is following (the total egg population could easily reach into several millions). Some discussion of this problem is required, besides just asking for a very fast computer. The experiemntal and modeling approach are likely to add to our base of knowledge concerning temperature related effects of project operation on chinook salmon egg development. It is nicely coupled to meaningful information on operational choices and will be beneficial to water managers as operational strategies are being developed and implemented.</p>
<b>Rating</b>	very good

## Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success?  
Is the scale of the project consistent with the objectives and within the grasp of authors?

<b>Comments</b>	<p>The experimental and field approaches are technically feasible. The modeling approach is also tecnhnically feasible if the population of eggs being individually modeled is evaluted or reasonably constrained. This author seems quite capable of carrying out this research and has a high likelihood of success. Although not experienced with chinook salmon egg development, his experience with riverine cichlid fishes should be transferrable.</p>
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### Technical Review #3

<b>Rating</b>	very good
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## Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

<b>Comments</b>	Not applicable.
<b>Rating</b>	not applicable

## Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

<b>Comments</b>	The use of a combined experimental and modeling approach should make the products of this research of high value. However, the cost associated with the laboratory experiments could be reduced if the temperature range of operational interest were better defined (instead of going up by 2 degree steps over an undefined range). The ability to evaluate operational alternatives with an individual based model would be an important and significant product of this research. If the nexus to operationally induced temperature changes in the river were demonstrated in a more convincing manner, one could see that this product could be important and significant.
<b>Rating</b>	very good

## Additional Comments

<b>Comments</b>	Overall I believe this study is meritorious. More information about the range of temperature changes actually seen in the system, and any evidence of delayed development (from out
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### Technical Review #3

	migrant studies) would significantly strengthen the proposal. Field monitoring within the redds, preceding detailed lab studies and modeling, could also serve to narrow the scope of studies.
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## Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The author has a commendable publication list that indicates a proven track record of past performance. I am not aware of any CALFED projects that he has worked on. The project team is primarily graduate students, who under the authors direction should be quite capable of carrying out this work. The author is requesting significant funds for laboratory equipment and computers to carry out this project; this would appear to be a short coming of their proposal (i.e., instead of utilizing already available resources).
Rating	good

## Budget

Is the budget reasonable and adequate for the work proposed?

Comments	Overall the budget seems reasonable, however, the need to purchase laboratory equipment and a fast computer is a handicap that adds cost to this proposal.
Rating	good

## Overall

Provide a brief explanation of your summary rating.

Comments	I view the problem identified as important, but rather generally defined. Specifics as to the range of
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Technical Review #3

	temperature variation in the project area and a nexus to operations have not been made. Field studies within redds could also help narrow the range of focus for both the laboratory and modeling efforts. The ability of the individual based modeling approach to track egg populations that could potentially number in the hundreds of thousands to millions is questionable. If the population modeled is reasonably constrained then the results are potentially important to water managers in that they could make informed decisions about how proposed releases could affect egg development.
Rating	good